Distribution Bias Aware Collaborative Generative Adversarial Network for Imbalanced Deep Learning in Industrial IoT

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Abstract

The impact of Internet of Things (IoT) has become increasingly significant in smart manufacturing, while deep generative model (DGM) is viewed as a promising learning technique to work with large amount of continuously generated industrial Big Data in facilitating modern industrial applications. However, it is still challenging to handle the imbalanced data when using conventional Generative Adversarial Network (GAN) based learning strategies. In this article, we propose a distribution bias aware collaborative GAN (DB-CGAN) model for imbalanced deep learning in industrial IoT, especially to solve limitations caused by distribution bias issue between the generated data and original data, via a more robust data augmentation. An integrated data augmentation framework is constructed by introducing a complementary classifier into the basic GAN model. Specifically, a conditional generator with random labels is designed and trained adversarially with the classifier to effectively enhance augmentation of the number of data samples in minority classes, while a weight sharing scheme is newly designed between two separated feature extractors, enabling the collaborative adversarial training among generator, discriminator, and classifier. An augmentation algorithm is then developed for intelligent anomaly detection in imbalanced learning, which can significantly improve the classification accuracy based on the correction of distribution bias using the rebalanced data. Compared with five baseline methods, experiment evaluations based on two real-world imbalanced datasets demonstrate the outstanding performance of our proposed model in tackling the distribution bias issue for multiclass classification in imbalanced learning for industrial IoT applications.